Vienna University of Technology,  
Faculty of Informatics,  
Institute of Computer Graphics and Algorithms,  
Pattern Recognition and Image Processing Group

DiplDiss Seminar  
Winter Term 2016  
November 8th 2016

**Program:**

13:00-13:05 *Opening* (Walter Kropatsch, Barbara Koneczny)

13:05-13:15 *On Hierarchies and Relations of Workflow Properties in Robustness Diagram with Loop and Time Controls* (Jasmine A. Malinao)

13:15-13:25 *Shape description and graph representation using topology and local features* (Ines Janusch)


13:35-13:45 *Train Detection and Tracking in OTDR Signal* (Adam Papp)

13:45-13:55 *Environment recognition for construction machines* (Markus Kessler)

13:55-14:05 *Shape Normalizing and Tracking Dancing Worms* (Daniel Pucher)

14:05-14:15 *Development of a pose-independent representation of 2D horse shapes* (Julian Pegoraro)

14:15-14:25 *System analysis and Calibration in Smile Project* (Gianluigi Mucciolo)

14:25-14:35 *Birds Watching - Features to characterize birds’ dancing* (Leonardo Oliva)

14:35-14:45 *Model and corresponding free multi-camera calibration* (Majid Banaeyan)

14:45-14:55 *Parallel Image Alignment based on LBP Pyramids* (Hanna Huber)

14:55-15:05 *Closing* (Walter Kropatsch, Barbara Koneczny)
On Hierarchies and Relations of Workflow Properties in Robustness Diagram with Loop and Time Controls (Jasmine A. Malinoa, PhD)

In this research, model properties that are formulated for well-known workflows such as Petri-nets, workflow-nets, and Business Process Modelling and Notation, are adopted for Robustness Diagram with Loop and Time Controls (RDLT). The formulations of these properties for RDLTs account the integrated environment found in these models with respect to the well-known workflow dimensions. These dimensions are case, process, and resource. This environment is further enriched by including in RDLTs concepts and mechanisms that introduce persistence and volatility in their structures and behavior. In particular, this research focused on the concept of soundness and free-choiceness in RDLTs. Furthermore, this research introduced definitions of properties relating to the use and implementation of constraints and topology in models that affect reachability. Specifically, this research introduced deadlock-freeness, non-self controlling structures, boundedness of reachable vertices, synchronicity of task executions, maximally-composed structures, etc., for both persistent and volatile structures in RDLTs. The formulation of these properties was supported by the introduction of special types vertices, arcs, Points-of-Interests(POIs), and the resulting substructures in RDLTs that are brought about from them. From these information, different structural and reachability profiles can be generated where different metrics are computable in polynomial time wrt model size. These profiles were used further to determine the hierarchies and relationships of the proposed model properties in RDLTs. Therefore, this research provided mechanisms of property verification that can bypass the use of the algorithm for activity extraction in RDLTs. This verification can now essentially be performed by referencing these hierarchies and relationships of these model properties that are determinable using the statically-available information from RDLTs.

Shape description and graph representation using topology and local features (Ines Janusch, PhD)

Small perturbations in a shape’s boundary or changes of minor shape details may alter the topology of a graph representation of this shape and therefore complicate shape classification and recognition. A shape descriptor based on the persistence of LBP classes over a range of radii (LBP scale-space) centred at critical points of the shape’s skeleton was therefore introduced. Extensions of this shape descriptor showed that the centre of the LBP scale-space does not necessarily have to be located at critical points of the skeleton, but that the accuracy of the reconstruction of the shape based on this descriptor is dependent on the location of the centre. Thus, future research will consider an approach to classify locations within a shape according to the quality of the shape description regarding the accuracy of the shape reconstruction. A future aim is to define a graph-based shape representation based on such well suited LBP scale-space locations as nodes.

Markerless Tracking of Facial Features for Facial Palsy Analysis (Barbara Koneczny, MSc)

Facial nerve paralysis is a paralysis of the muscles which are innervated by the seventh cranial nerve, resulting in partial or total paralysis of the muscle tone. This causes restrictions of the neural actuation of muscles responsible for facial expressions which causes asymmetric facial movement. A way to treat facial palsy is to apply neuromuscular reconstruction methods. The evaluation of the healing process and the progress in reestablishing the muscle tone and symmetric facial movement is essential for the further treatment of the patient. The currently used system for estimating the progress after the surgery lacks in precision and time efficiency. In order to separate the head motion and the motion arising from the facial muscle tonus an object based coordinate system was introduced. The object based coordinate system can also be used to predict the 3D position and
projected position in the image of an observation point. This predicted position indicates the position where the observation point should be, if there is no motion arising from the facial muscles.

Train Detection and Tracking in OTDR Signal (Adam Papp, MSc)
This thesis investigates the use of an Optical Time Domain Reflectometry (OTDR) device for railway safety improvement. OTDR sensing, often also termed Distributed Acoustical Sensing (DAS), measures the Rayleigh backscattering of a light pulse along an optical fiber. The resulting signal provides information on local acoustic pressure at linearly spaced segments, corresponding to positions, along the fiber. We propose a novel method for the detection of vibrations caused by trains in an optical fiber buried within a few meters from the railway track. Using optical time-domain reflectometry vibrations in the ground caused by different sources can be detected with high accuracy in time and space. The presented method learns the characteristic pattern in the Fourier domain using a Support Vector Machine (SVM) and it becomes robust to background noise in the signal. We show that using General Purpose Graphical Processing Unit (GPGPU) it is possible to compute feature values relevant for train detection in real-time. For the tracking of trains, a point-based causal algorithm is presented. The tracking has two stages to minimize the influence of false classifications of the vibration detection and solved as an optimization problem. While several algorithms have been demonstrated in the literature for train tracking using OTDR signals, they have not been tested on longer recordings with a large number of train samples. In contrast to that, our data contains a number of railway stations and train trajectory crossings over two hours under realistic conditions. To our knowledge, the presented algorithm is the first one in the literature which is tested against ground truth of train trajectories from a conventional train tracking system.

Environment recognition for construction machines (Markus Kessler, BSc)
Liebherr, an equipment manufacturer company, develops different kinds of construction machines that are equipped with back view cameras. The aim of this work is to analyze the camera pictures taken by such cameras and to recognize threats like pedestrians, which should be highlighted and visualized. Therefore, motion deduced by the camera must be eliminated followed by the detection of moving blobs.

Shape Normalizing and Tracking Dancing Worms (Daniel Pucher, BSc)
During spawning, the marine worms Platynereis dumerilii exhibit certain swimming behaviors, which are described as nuptial dance. To address the hypothesis that characteristic male and female spawning behaviors are required for successful spawning and fertilization, we propose a 2D tracking approach enabling the extraction of spatio-temporal data to quantify gender-specific behaviors. One of the main issues is the complex interaction between the worms leading to collisions, occlusions, and interruptions of their continuous trajectories. To maintain the individual identities under these challenging interactions a combined tracking and re-identification approach is proposed. The re-identification is based on a set of features, which take into account position, shape and appearance of the worms. These features include the normalized shape of a worm, which is computed using a novel approach based on its distance transform and skeleton.

Development of a pose-independent representation of 2D horse shapes (Julian Pegoraro, BSc)
The aim of this work is to create a pose-independent representation of a horse. In order to enable this, we need an image as input, which contains a pose from a single horse. The first step is to segment the horse on the image. In this step, the shape and its boundary are obtained, and a binary mask will be created. The second step is to find the marker, which are painted on the horse. These markers can be found in the boundaries of the shape, which was created in the first step. The third step is to determine the medial axis of the shape, which was created in the first step. On each point
of the medial axis will be inserted a circle, which increases, until it touches the boundary of the horse shape. The medial axis will be transformed into straight lines and to a specific length, which makes it easier to compare it with each other. In the last step, the markers and the transformed medial axis are used to normalize the pose of the horse. After each step, a review and a possible correction can be made. For each step it is important to find out, how accurate it works and how much user interaction is required to mend disturbances and inaccuracies. In addition, it should be evaluated in which of the steps occur most errors, and how these errors can be minimized. Such a normalized representation of the horse will allow comparing different horses and measuring between-animal variations, which are interesting and essential for breeding.

**System analysis and Calibration in Smile Project (Gianluigi Mucciolo, MSc)**

SMILE is project involved in analysis of facial nerve paralysis. When we talk about facial nerve paralysis we refer to a paralysis of the muscles which causes asymmetric facial movement. Now, the only way to treat facial palsy is to apply a surgery. The physicians need to measure the progress by extract information from those locations of the face which provide most information about the facial expression. Those locations are indicated by small artificial markers placed on the face. Picture by picture, all static and dynamic points of the face in the frontal and the two mirror views are marked with the mouse. The same is done for picture of the calibration grid and its two mirror images to be independent from the angle of mirrors by using the relative position of points taken from two type of image. The aim of the whole project is to automate the tracking process and then to establish marker less tracking of facial features. To accomplish this result, we should solve some problems before, at this purpose, the aim of my project is to study the mirror system in order to find the relationship between: Left mirror angle, Right mirror angle, Patient head position, Camera position, this is useful for know how many faces could be visible by changing previous parameters. Then I will explain the proposed calibration device and the calibration process, so that we will be able to map more 2D points to a single 3D point.

**Birds Watching - Features to characterize birds' dancing (Leonardo Oliva, MSc)**

During their dancing, the birds belonging to the Golden Collared Manaking race exhibit some behaviours that would be really interesting to understand how female birds choose the male ones. In this work we will explain how we can efficiently track the birds during their dancing, and how to extract the parameter to characterize the dance, using a smaller representation in respect of the full trajectory.

**Model and corresponding free multi-camera calibrations (Majid Banaeyan, PhD)**

Camera calibration provides a mapping between 3D real world of an observed scene and the corresponding 2D of the acquired image. Common calibration methods usually assume geometrical model or special parameters to correct distortion of the lenses. For this purpose, key points in epipolar lines or curves are extracted to solve the corresponding problem. On the other hand, a model and corresponding free calibration can be used for any arbitrary lens distortion. Moreover, it combines image alignment and distortion correction together as a single problem which is useful in image stitching applications. In this study, a new multi-camera calibration based on graph pyramid segmentation is investigated.

**Parallel Image Alignment based on LBP Pyramids (Hanna Huber, MSc)**

With increasing popularity of panoramic images, research in the field of efficient image stitching is encouraged. In collaboration with the film camera manufacturer Indicam, this master project aims at developing a new concept for parallel image alignment based on graph pyramids. Input images are aligned to a target coordinate system by performing Structurally Correct Image Segmentation.
(SCIS) which is based on Local Binary Patterns (LBPs). The target coordinate system is defined by a checkerboard pattern. To guarantee correct segmentation and to increase efficiency, the criteria of the SCIS algorithm are adjusted and crosspoint information is gathered in a preprocessing step.